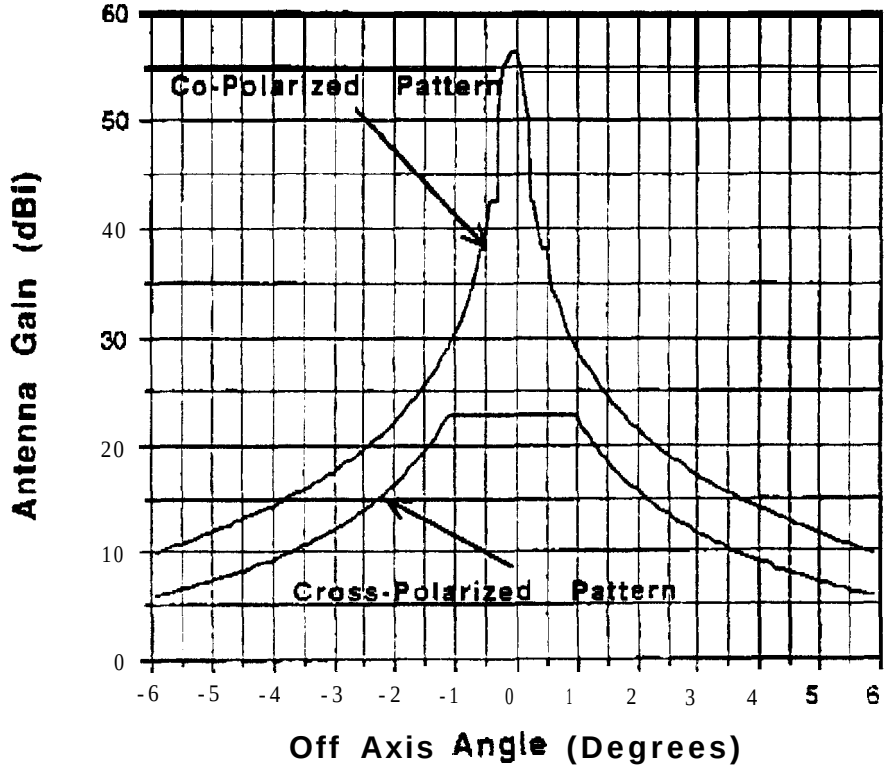

Figure 2-3: The Iridium E/S Transmit Co & Cross-Polarized Antenna Patterns (Based on CCIR Rec. No. 580 & 731)

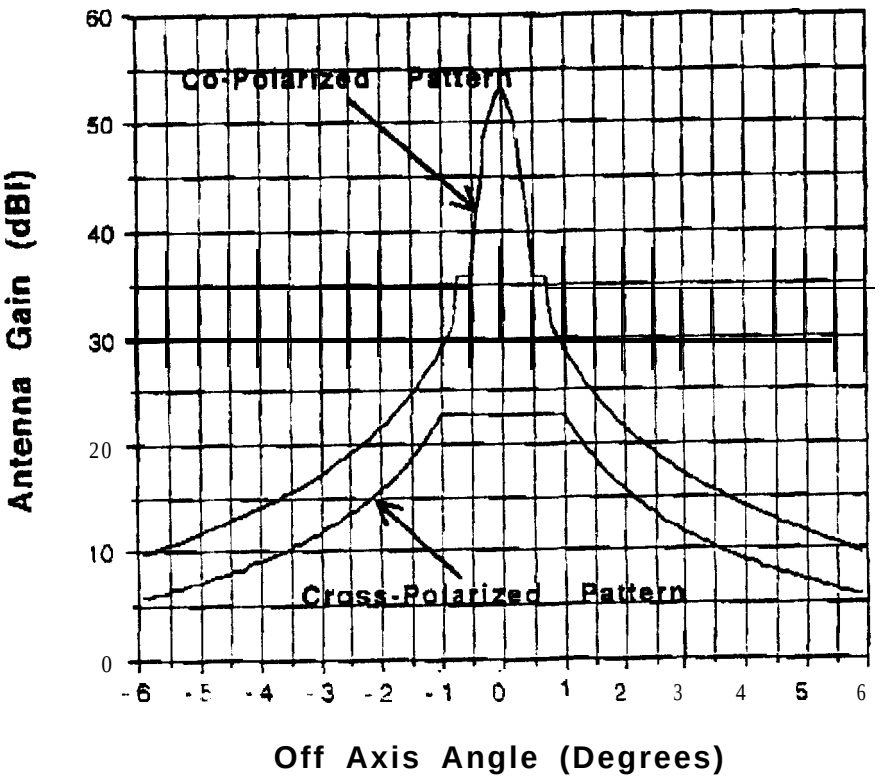

Figure 2-4: The Iridium E/S Receive Co & Cross-Polarized Antenna Patterns (Based on CCIR Rec. No. 580 & 731)

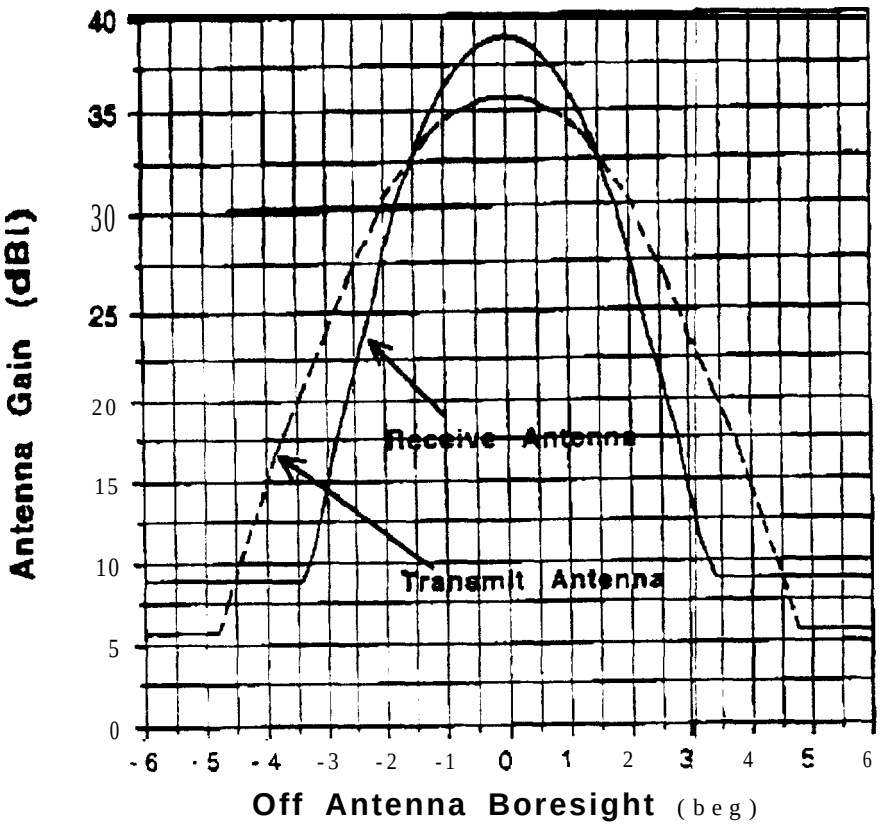

Figure 2-5: The Odyssey Receive and Transmit Satellite Antenna Patterns (Based on CCIR Rec. 558-4)

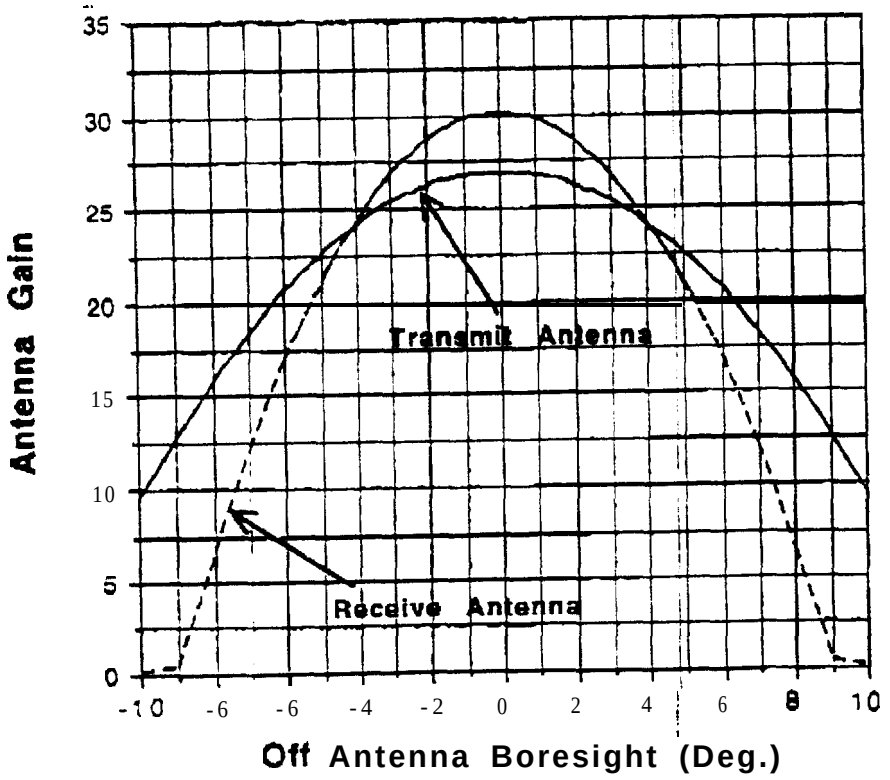

Figure 2-6: The Iridium Receive and Transmit Satellite Antenna Patterns (Based on CCIR Rec. 558-4)

3.0 Interference Analysis

The worst case, single-entry "in-line" interference events of the Odyssey satellite feederlinks and the Iridium satellite feederlinks in the 28/19 GHz band were performed. Two possible interference cases were considered:

Case #1 Uplink interference

- The Odyssey (NGSO MEO MSS) feederlink transmit earth station interfering with the Iridium satellite receiver

- The Iridium feederlink transmit earth station interfering with the Odyssey satellite receiver

Case #2 Downlink interference

- The Odyssey satellite transmit antenna interfering with the Iridium earth station receiver

- The Iridium satellite transmit antenna interfering with the Odyssey earth station receiver

In each case, the calculated interference level is based on the following assumptions:

* Five candidate earth station locations of the Iridium system were used in the calculation. Five potential Iridium earth stations in the United States are:

  ** Spokane, Washington
  ** Kansas City, Kansas
  ** Montpelier, Vermont
  ** Las Vegas, Nevada
  ** Atlanta, Georgia

* The candidate earth station locations of the Odyssey system were used for purposes of illustration only in the calculation. The potential Odyssey earth stations in the United States are:

  ** San Luis Obispo, CA - USA
  ** Portland. Maine

Due to the intermittent nature of "in-line" interference, it must be expressed in terms of short term allowances. There is no criteria for the acceptable interference level between two NGSO MSS feederlinks.

However, criteria for acceptable interference based on an allowable interference-to-noise ratio (I/N_T) for a given percentage of time was presented in the CPM Report, CPM 95/1 18 at 43 (Table 8A) (Apr. 1 1995). Based on the CPM Report, the interference due to NGSO MSS feeder link at the input to the demodulator receiving a digital carrier in the GSO/FSS network should not exceed any the following values:

Interference	Maximum % Time Exceeded (For 30/20 GHz Network)
Negligible (≤ 6%)	0.87
0.78 N_T	0.119
2.98 N_T	0.0294
14.80 N_T	0.0004

These criteria for acceptable interference are reasonable to use to compute the statistic for the interference between the Odyssey system and the Iridium system.

Figure 3.1 illustrates the potential interference of the Odyssey system and the Iridium system. The receive satellite/earth station antenna of the Odyssey (or the Iridium) receives interference from some of the transmit signal power generated by the transmit earth station/satellite of the Iridium feederlinks (or Odyssey feederlinks).

The calculated uplink and downlink interference were based on the following:

* All earth station transmit antennas meet the CCIR Recommendation 580

* The estimated satellite antenna patterns were based on the CCIR Recommendation 558-4

* The earth station transmit and receive antenna cross polarized patterns were based on the CCIR Recommendation 731.

Close spacing of the Odyssey system ground traces make it unlikely that the Odyssey constellation could be oriented to avoid interference with one or more Iridium satellites or vice versa . Figure 3-2 shows the 12 satellites in 24 hours of repeating ground traces for the Odyssey system. The triangles indicate the positions of the satellites at one time point.

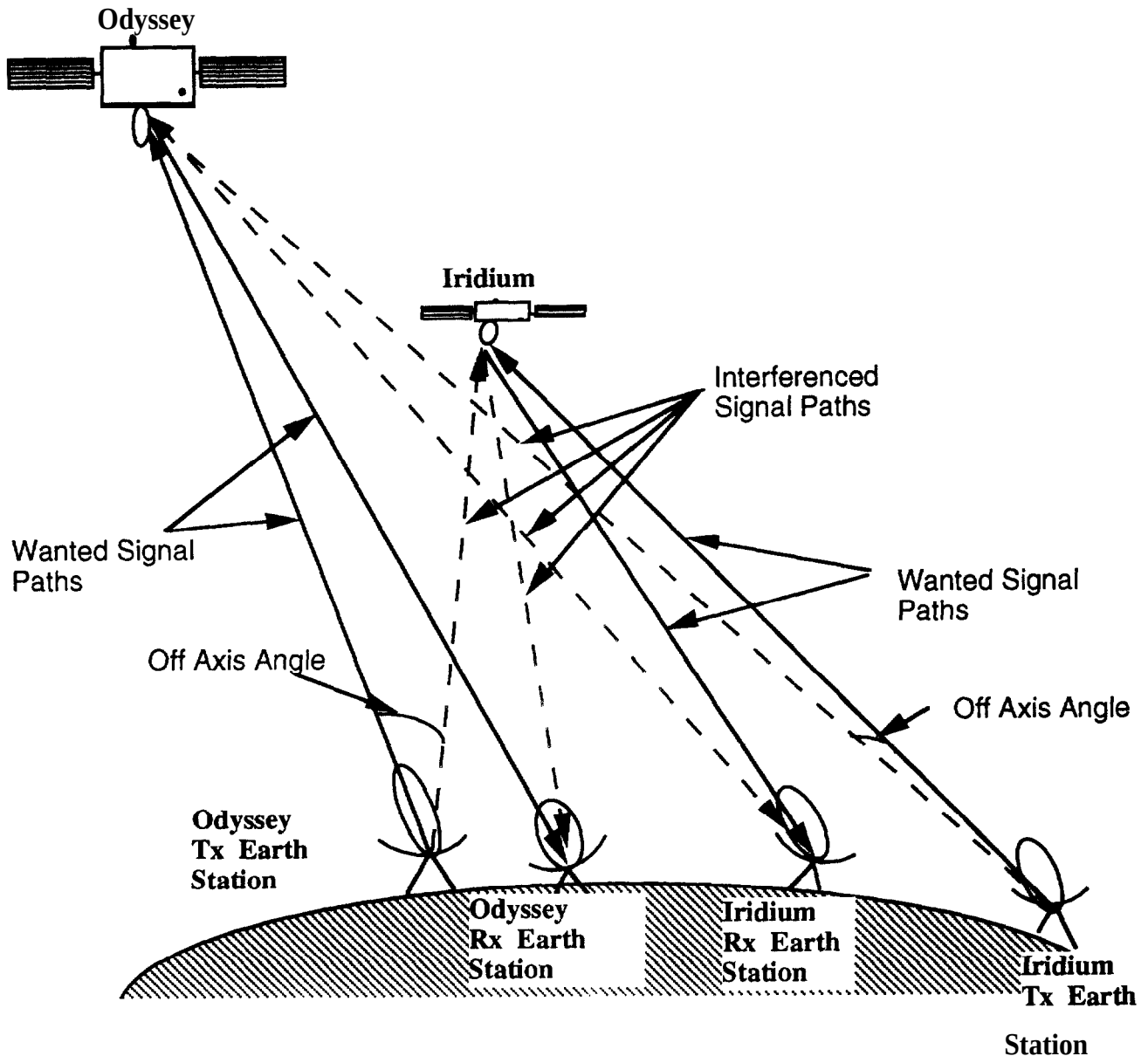

Figure 3.1: Interference Geometry Between The Odyssey and The Iridium Networks

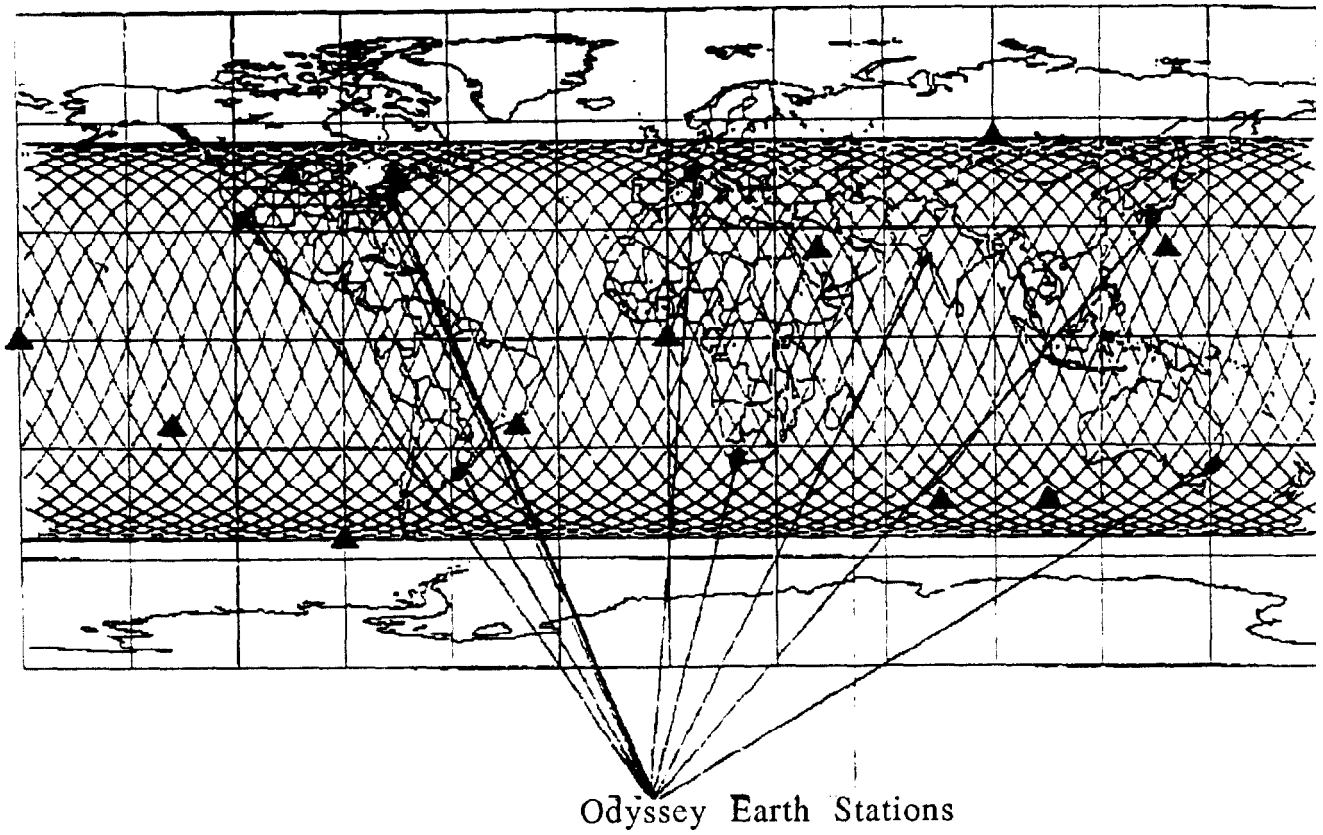

Figure 3-2: Odyssey Ground Trace (12 Satellites, 24 Hour Repeating Ground Traces)

For one case, we ran in 24 hour repeating ground traces with 12 Odyssey satellite constellation, all Odyssey earth stations associated with 12 Odyssey satellites will cause “in-line” interference with the Iridium system.

Figure 3-3 shows the number of occurrences versus off axis angle from the Odyssey earth station that Odyssey system causing “in-line” interference with the Iridium system.

Figure 3-4 shows the maximum interference duration vs off axis angle from the Odyssey earth station in which the Iridium system receiving interference from the Odyssey system.

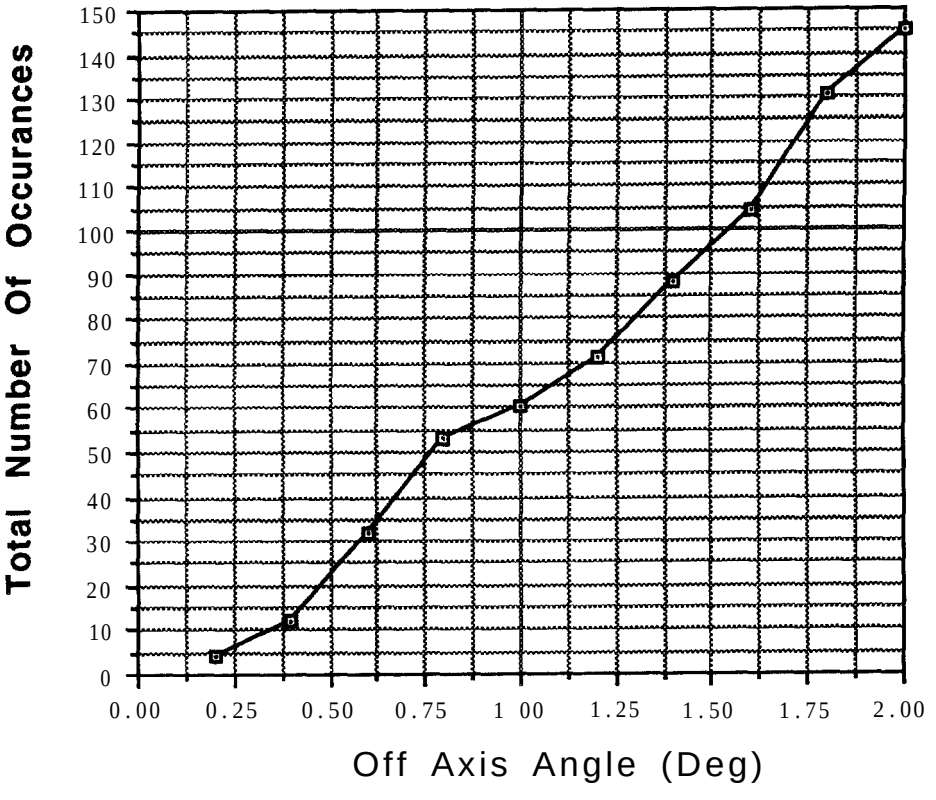

Figure 3-3: Total Number of Occurrences Vs Off Axis Angle

Figure 3-3 can be read as:

* Four Odyssey satellites would experience "in-line" interference with Iridium satellites coming within 0.2" off axis angle from the Odyssey earth stations.

Figure 3-4 can be read as:

* The maximum interference duration in which the Iridium system would receive interference from the Odyssey system is 0.04 minutes at 0.2" off axis angle from the Odyssey earth station.

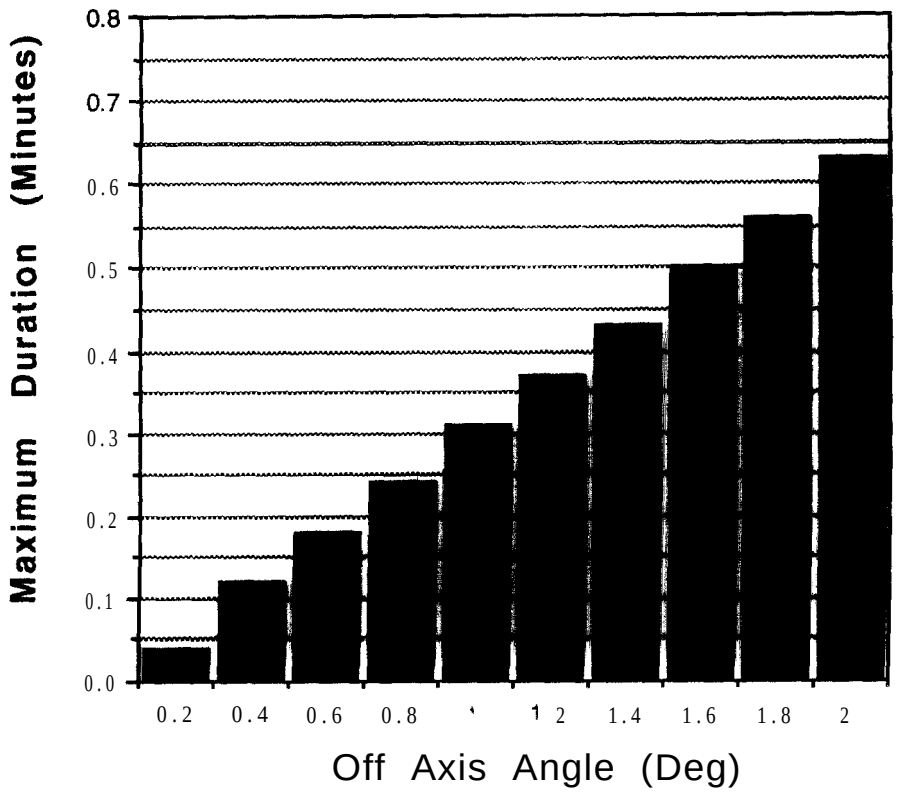

Figure 3-4: Maximum "in-line" Interference Duration Vs Off Axis Angle

3.1 The Potential Uplink and Downlink Interference Between The Odyssey System and The Iridium System.

3.1.1 Iridium Victim

Figure 3-5 illustrates the Odyssey earth station interference with the Iridium satellite.

Figures 3-6, 3-7, 3-8, 3-9 and 3-10 shows the potential interference between the Odyssey earth station at San Luis Obispo and the Iridium satellites viewing the Iridium earth stations at Spokane, Kansas City, Montpelier, Las Vegas and Atlanta, respectively.

Figures 3-11, 3-12, 3-13, 3-14 and 3-15 shows the potential interference between the Odyssey earth station at Portland (Maine) and the Iridium satellites viewing the Iridium earth station at Spokane, Kansas City, Montpelier, Las Vegas and Atlanta, respectively.

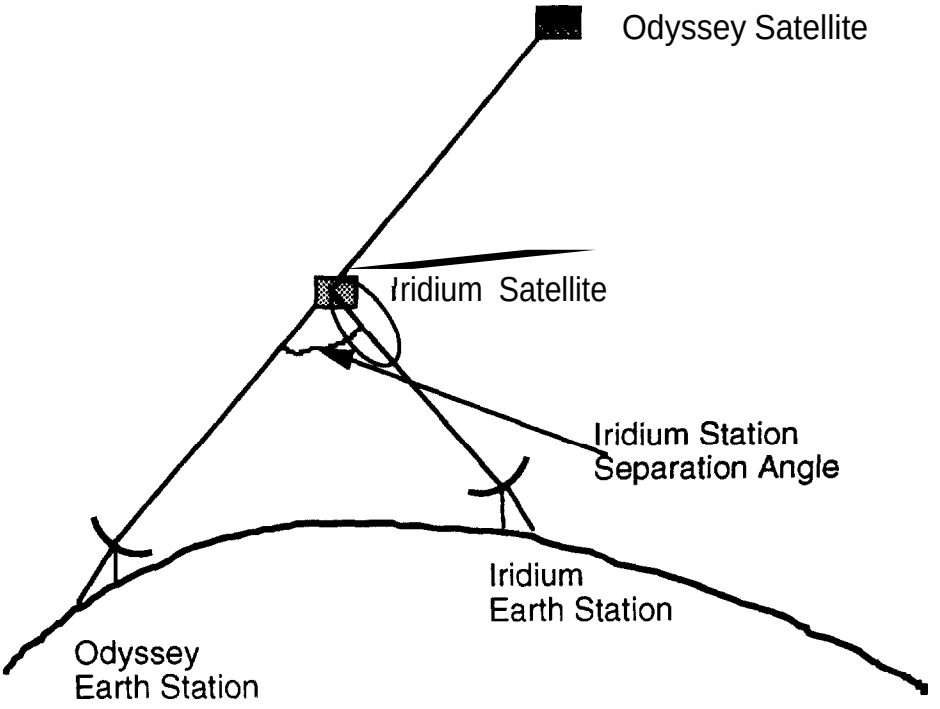

Figure 3-5: Odyssey Station Interference With The Iridium Satellites

3.1.1.1 Uplink interference (Interference with Iridium Satellite)

The potential worst case interference is when the Iridium satellites viewing the Iridium earth station at Montpelier and Las Vegas receive interference from the Odyssey earth stations at Portland (Maine) and San Luis Obispo, respectively.

In the calculation, we assume the following:

* Minimum Odyssey earth station elevation angle is 10”
* The Iridium station angle is:
  ** Iridium satellite viewing the Iridium earth station at Montpelier: 3.8°
  (See Figure 3-13)
  ** Iridium satellite viewing the Iridium earth station at Las Vegas: 9.6”

Table 3-l summarized the potential interference between Odyssey earth stations and the Iridium satellites

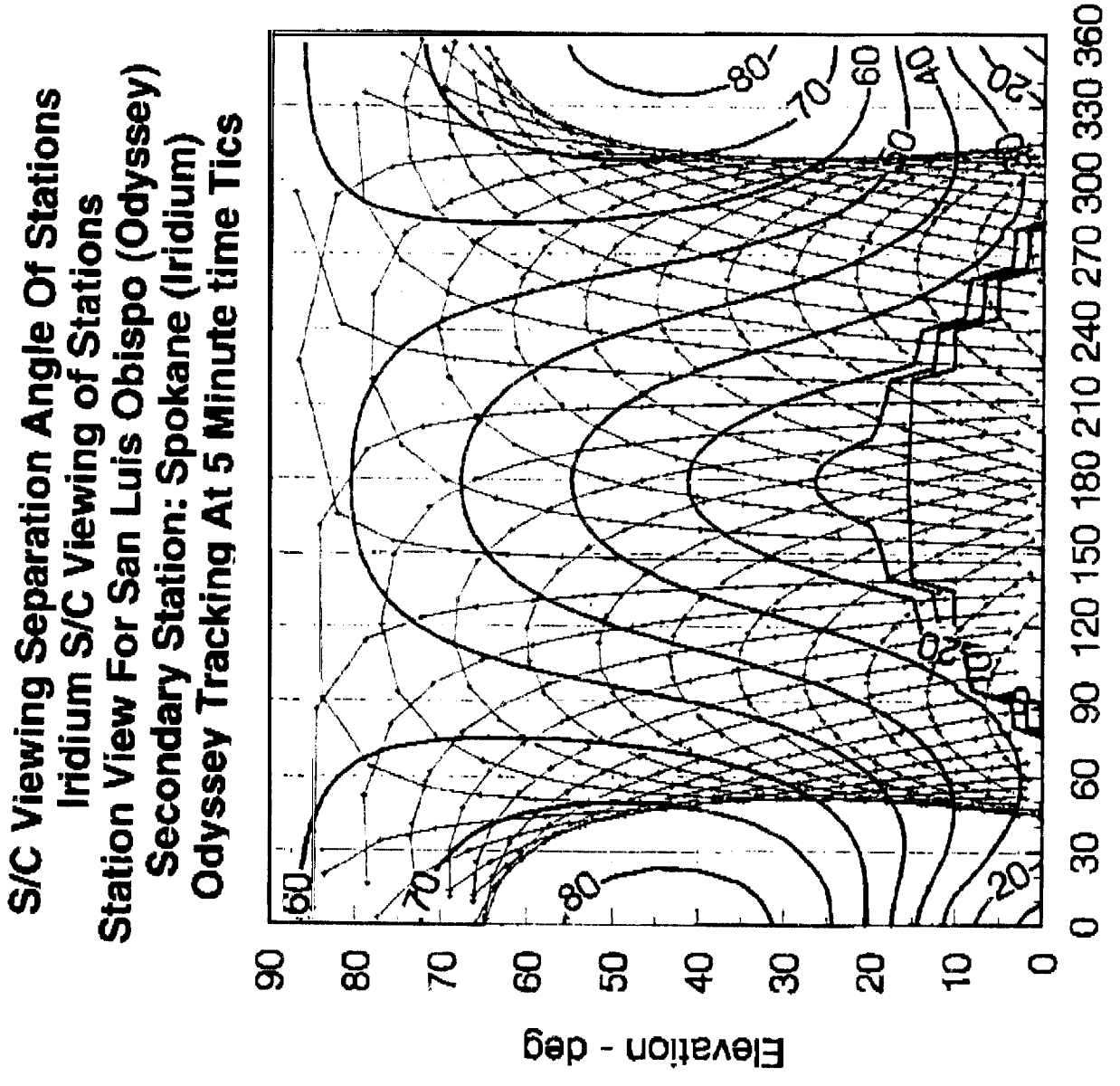
S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For San Luis Obispo (Odyssey)
Secondary Station: Spokane (Iridium)
Odyssey Tracking At 5 Minute time Tics
Elevation - deg
Azimuth - deg
0 10 20 30 40 50 60 70 80 90
0 30 60 90 120 150 180 210 240 270 300 330 360
60
70
80
20
40

Figure 3-6

S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For San Luis Obispo (Odyssey)
Secondary Station: Kansas City (Iridium)
Odyssey Tracking At 5 Minute time Tics

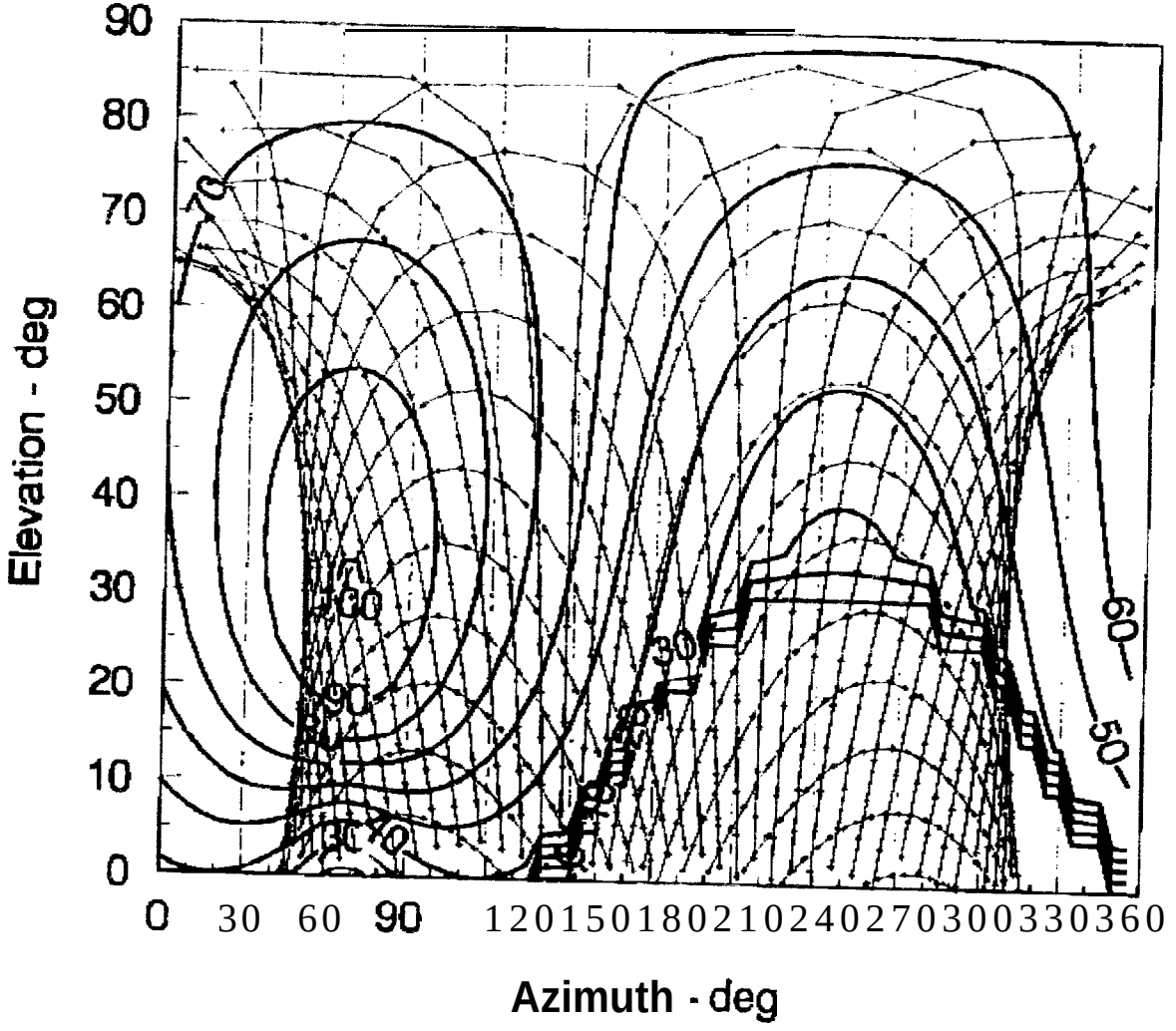

Figure 3-7

S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For San Luis Obispo (Odyssey)
Secondary Station: Las Vegas (Iridium)
Odyssey Tracking At 5 Minute time Tic

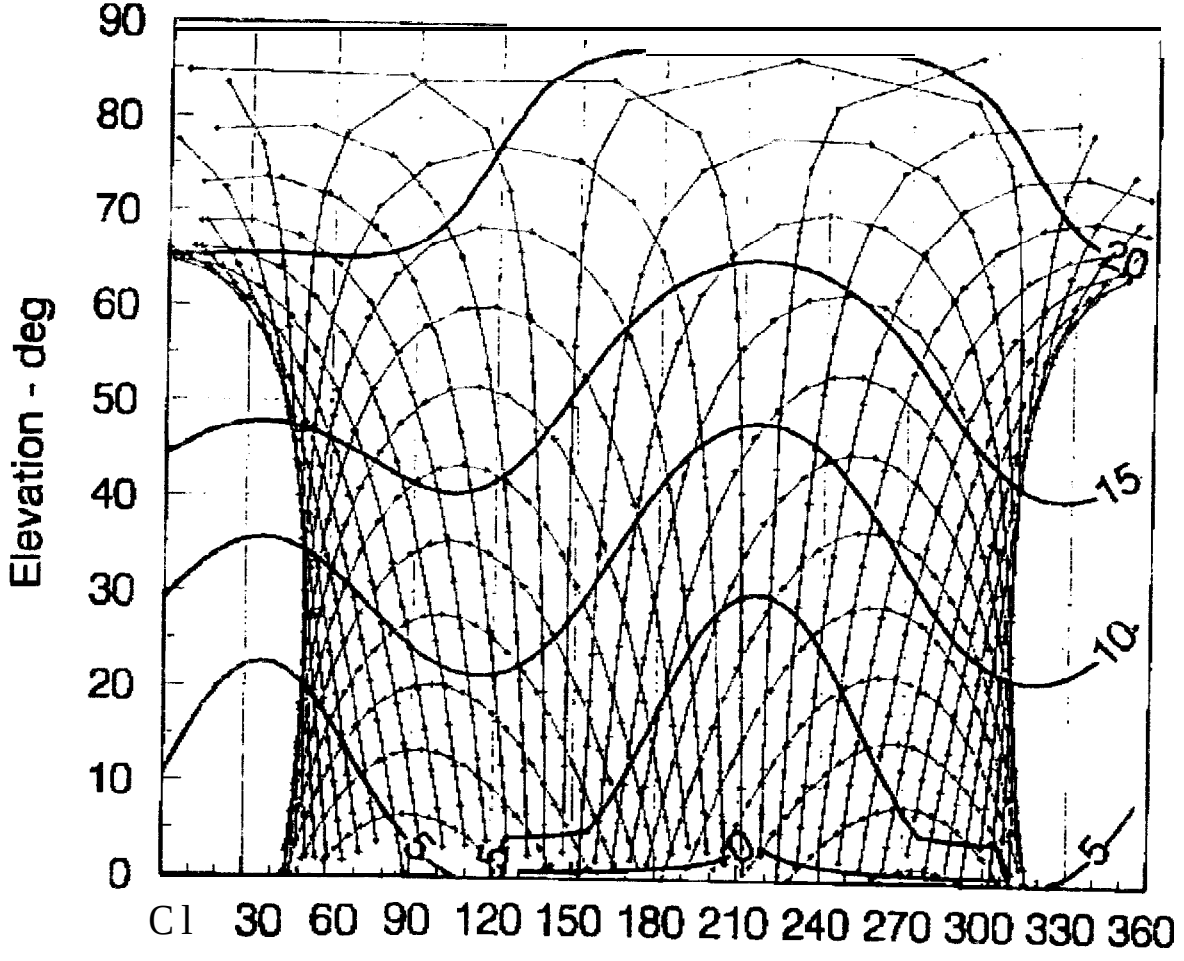

Figure 3-9

SEP. -0. 95(THU) 15:14 ODYSSEY SERVICES ORG TEL:310 814 1400 P.008

S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For San Luis Obispo (Odyssey)
Secondary Station: Atlanta (Iridium)
Odyssey Tracking At 5 Minute time Tics

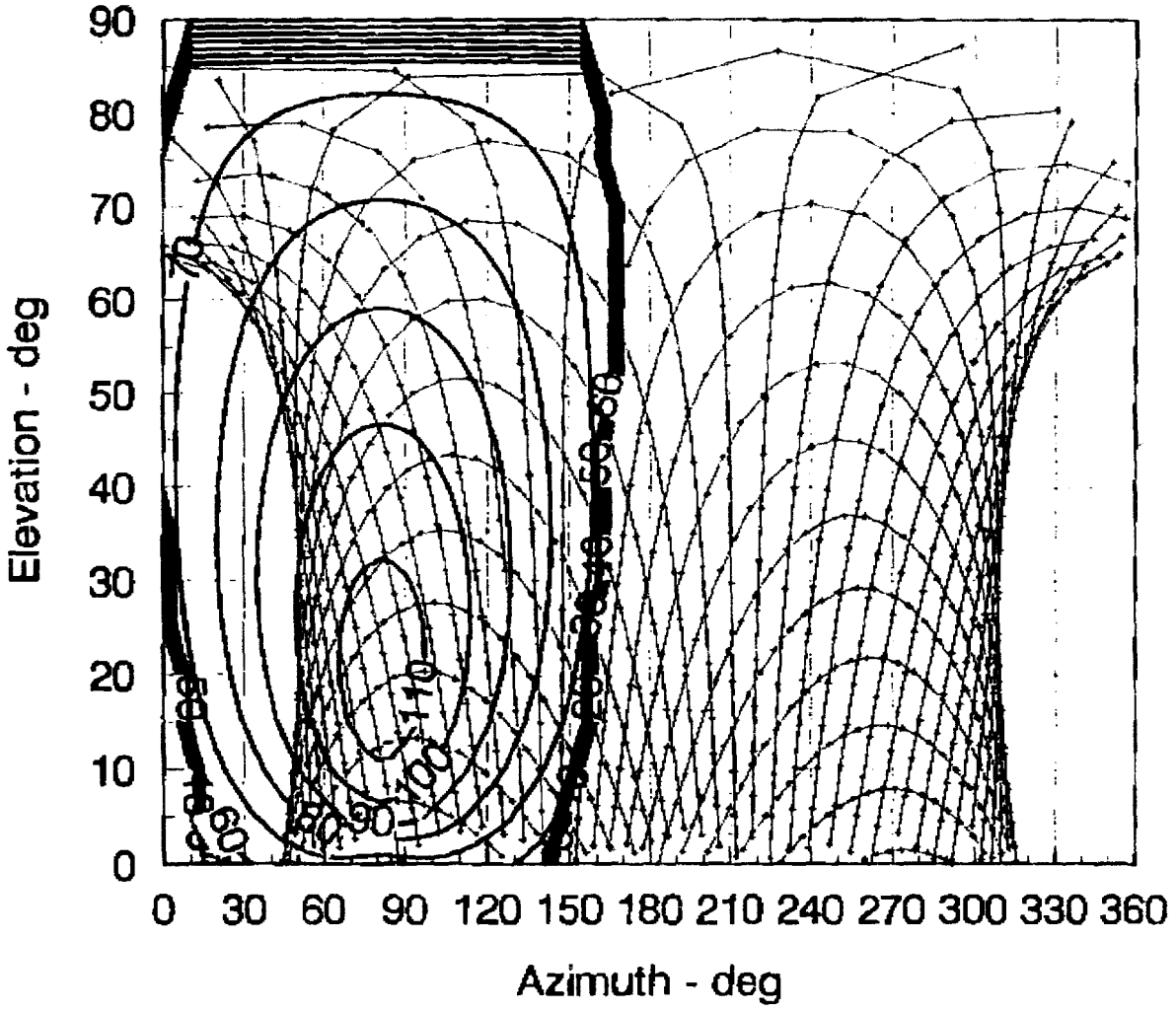

Figure 3-10

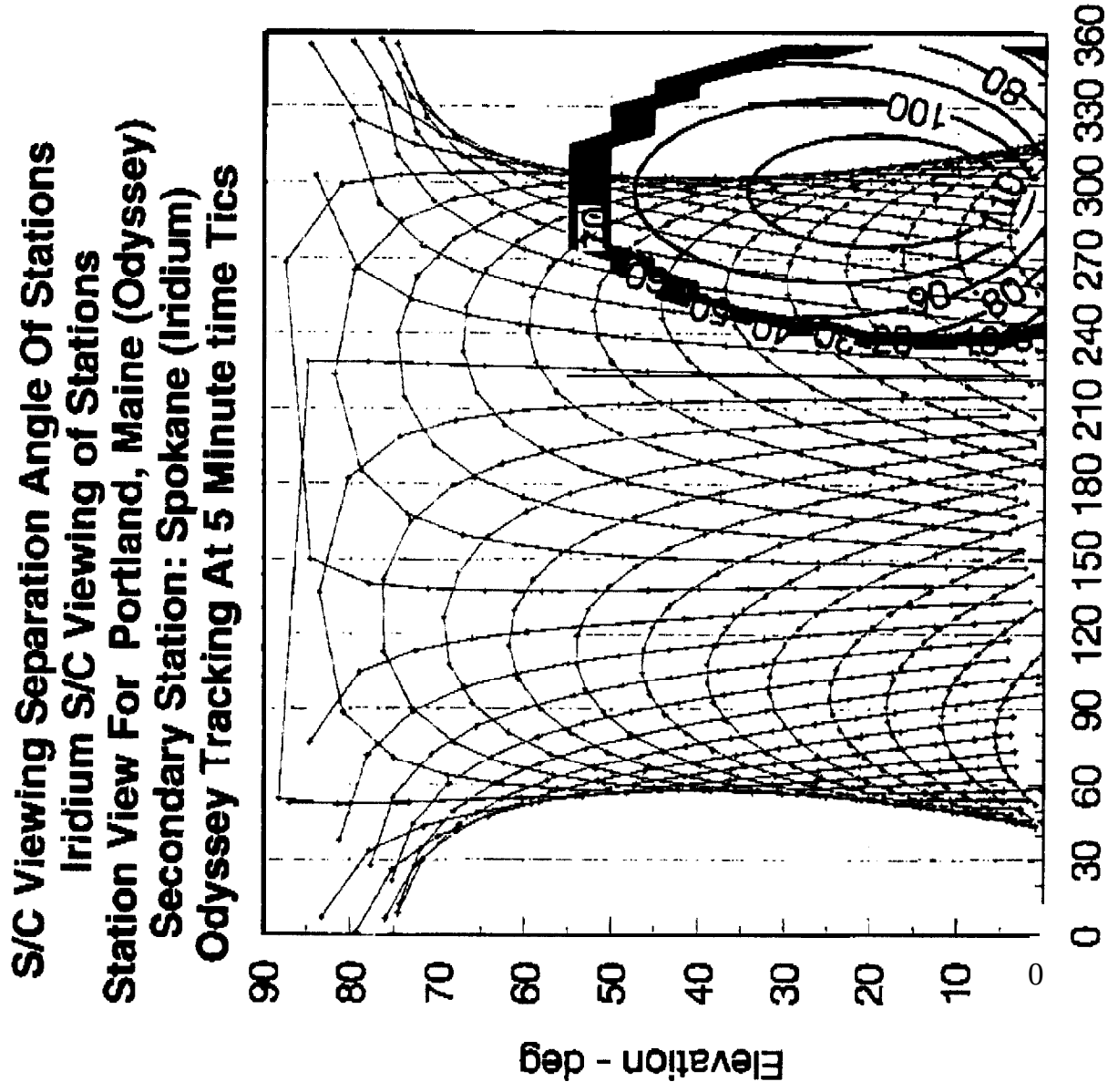
S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Spokane (Iridium)
Odyssey Tracking At 5 Minute time Tics
Elevation - deg
90
80
70
60
50
40
30
20
10
0
0 30 60 90 120 150 180 210 240 270 300 330 360
Azimuth - deg

Figure 3-11

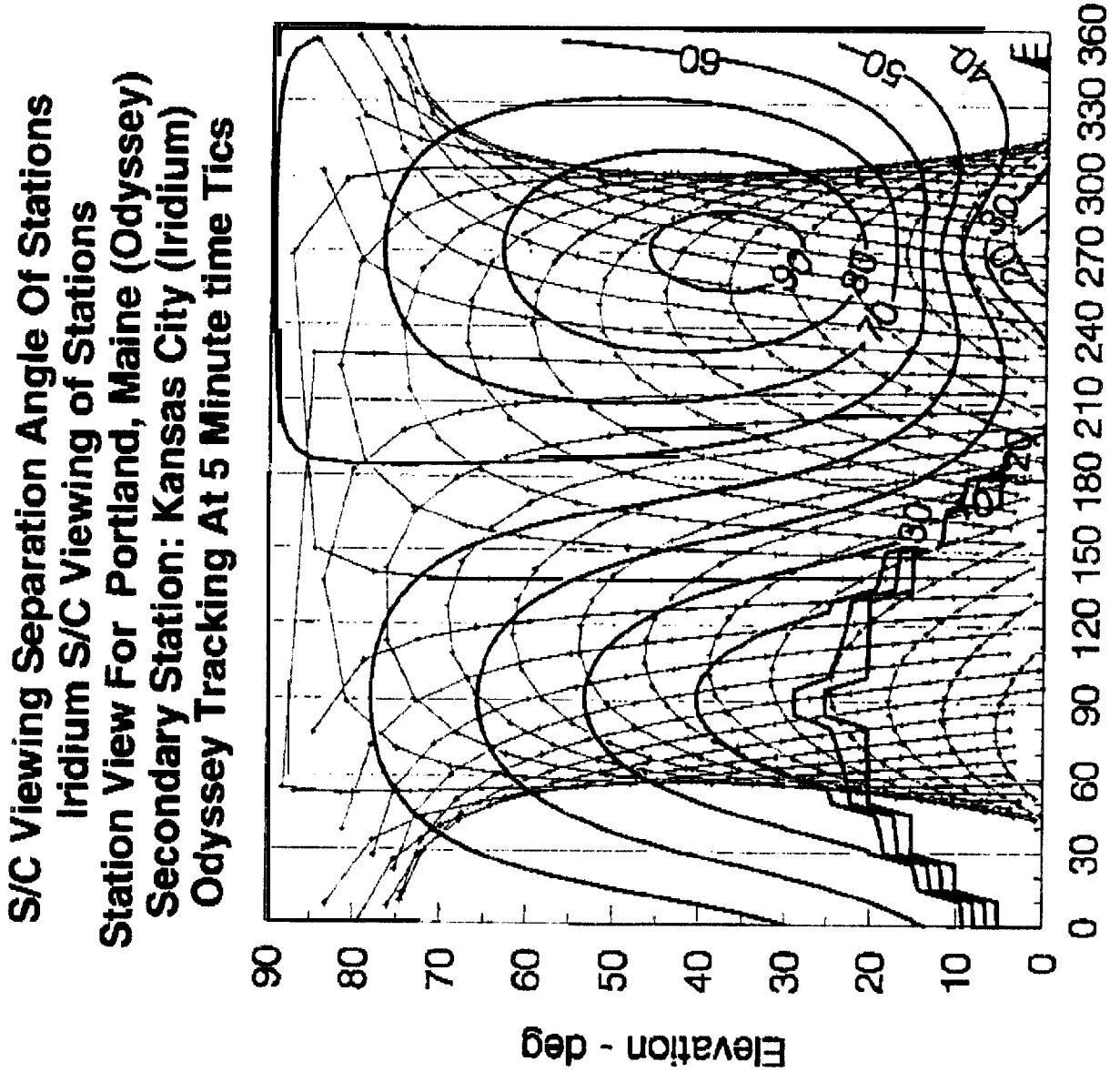
S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Kansas City (Iridium)
Odyssey Tracking At 5 Minute time Tics
Elevation - deg
Azimuth - deg
0 30 60 90 120 150 180 210 240 270 300 330 360
0 10 20 30 40 50 60 70 80 90
60
50
40
30
20
10
E

Figure 3-12

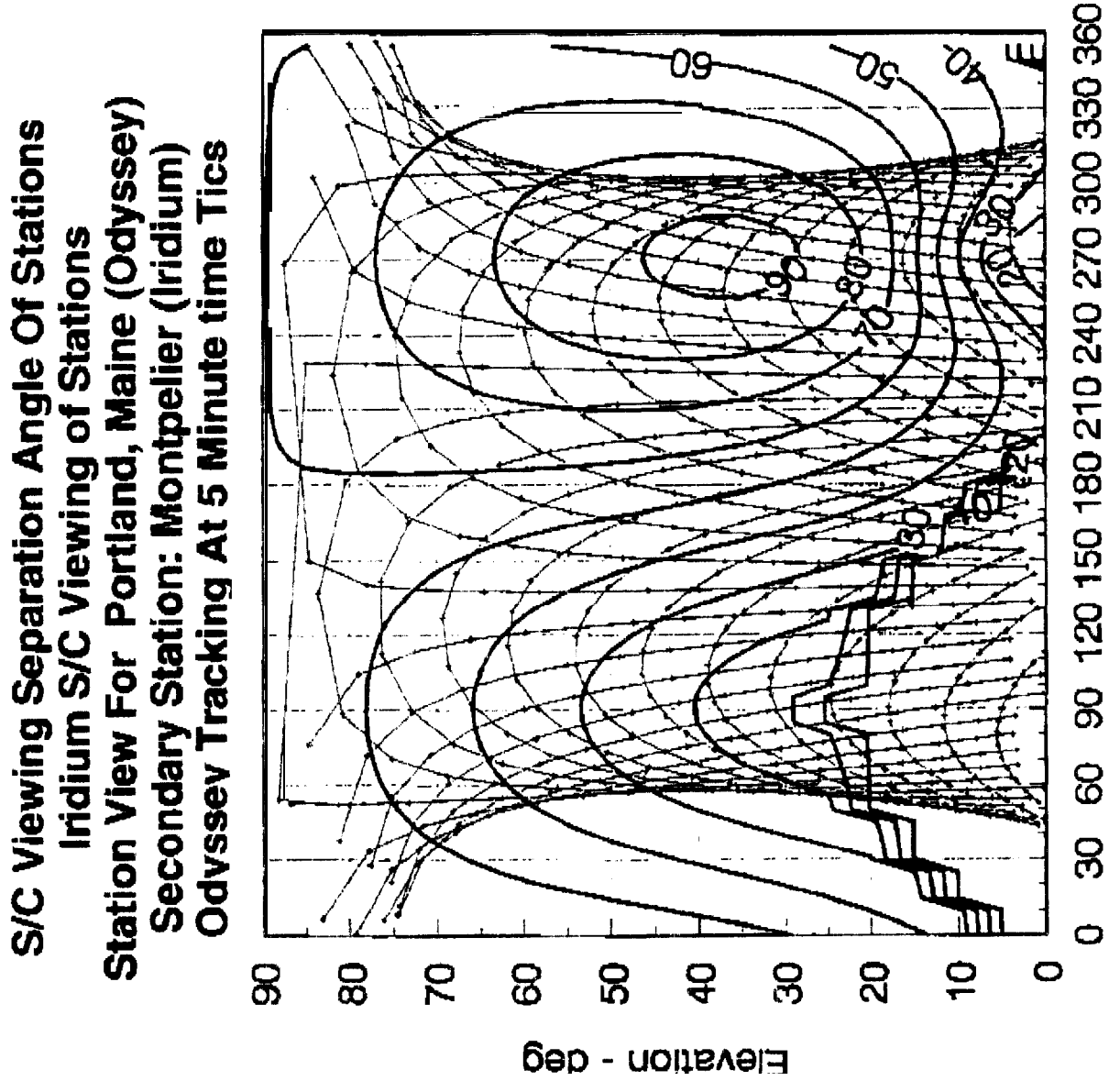
S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Montpelier (Iridium)
Odyssey Tracking At 5 Minute time Tics
Elevation - deg
Azimuth - deg
0 30 60 90 120 150 180 210 240 270 300 330 360
90 80 70 60 50 40 30 20 10 0
60
50
40
30
20
10
E

Figure 3-13

S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Las Vegas (Iridium)
Odyssey Tracking At 5 Minute time Tics

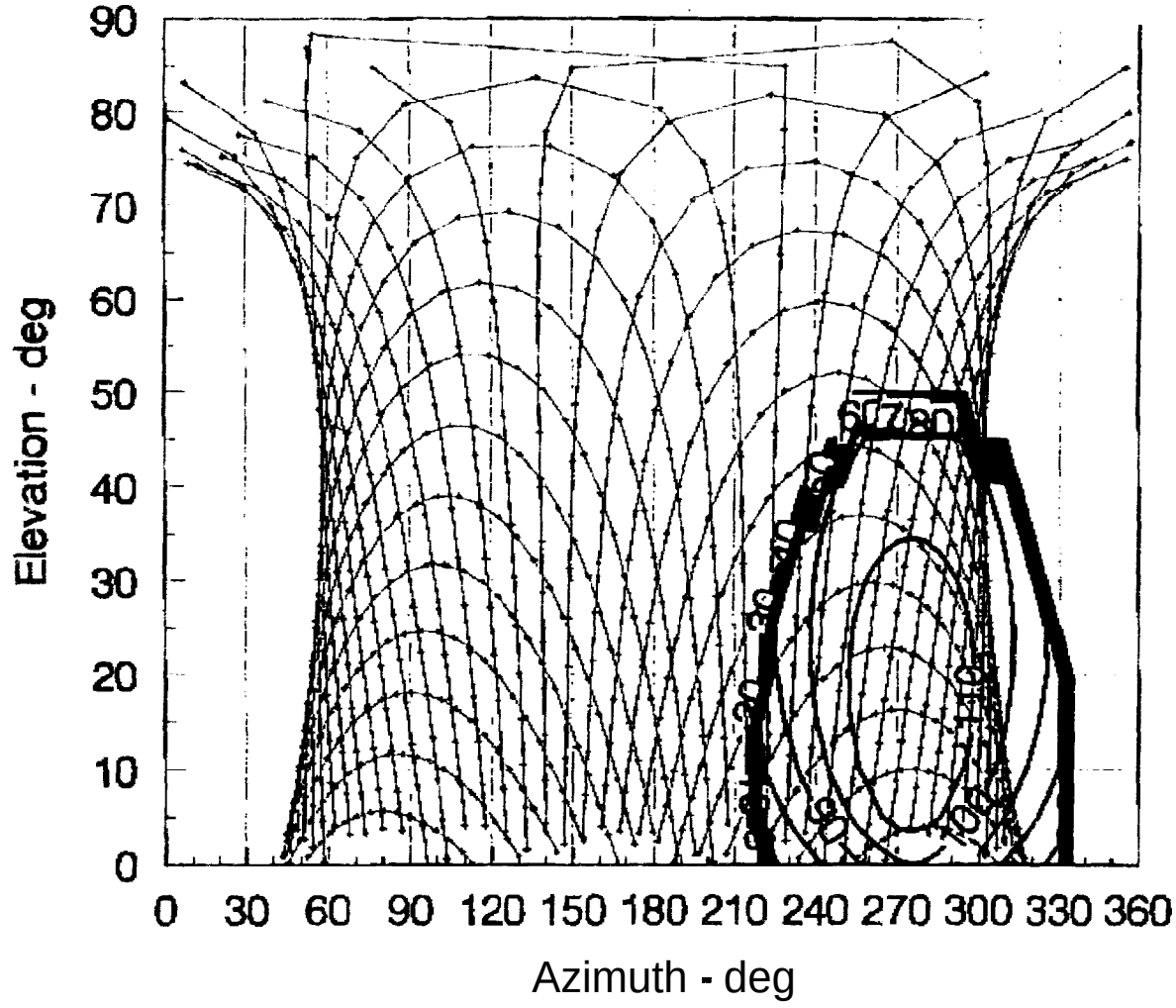

Figure 3-I 4

SEP -07 '95(THU) 13:13 ODYSSEY SERVICES ORG TEL:310 814 1400 P.005

S/C Viewing Separation Angle Of Stations
Iridium S/C Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Atlanta (Iridium)
Odyssey Tracking At 5 Minute time Tics

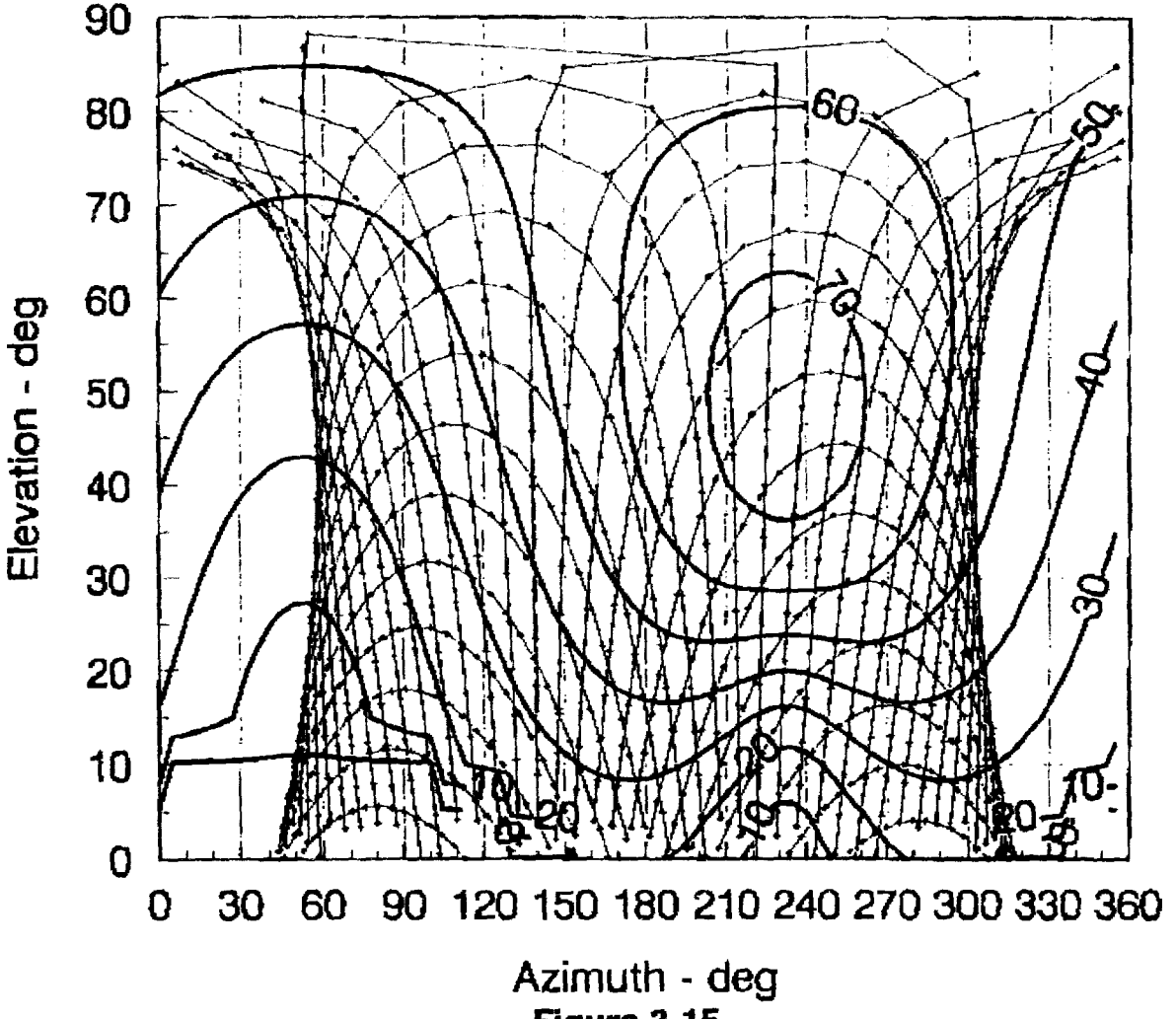

Figure 3-15

Table 3-l: Interference Level At the Iridium Satellite

Recommended Criteria		Interference Level At the Iridium Satellites	
Max Allowed %Time	Interference Level	- From Odyssey E/S at San Luis Obispo - Viewing to Iridium E/S At Las Vegas	- From Odyssey E/S at Portland (Maine) - Viewing to Iridium E/S At Montpelier
I= 0.06 N_T	-		
I = 0.78 N_T	0.0001 N_T		0.0006 N_T
0.0294	0.0001 N_T		0.0154 N_T
0.00048 N_T	0.004 N_T		1.1983 N_T

From Table 3-1, we conclude that the interference level at the Iridium satellite would be well below the recommended level.

3.1.1.1 Downlink interference (Interference with Iridium Earth Station

As is the case with the uplink assumptions, the potential interference between Odyssey satellites and the Iridium earth stations are shown in Table 3-2

Table 3-2: Interference Level At Iridium Earth Stations

Recommended Criteria		Interference Level Iridium Earth Stations at	
Max Allowed %Time	Interference Level	- From Odyssey Satellite Viewing Odyssey E/S at San Luis Obispo - Iridium Earth Station at Las Vegas	-From Odyssey Satellite Viewing Odyssey E/S at Portland (Maine) - Iridium Earth Station at Montpelier
0.87	I= 0.06 N_T		
0.119	I = 0.78 NT	0.0737 N_T	0.1339 N_T
0.0294	I = 2.98 N_T	1.7750 N_T	3.2238 N_T
0.0004	I = 14.8 N_T	3.3100 N_T	6.0117 N_T

From Table 3-2, we conclude that

* The interference level at the Iridium Earth Station at Las Vegas would be well below the recommended level.

* The interference level at the Iridium earth station at Montpelier would be 0.34 dB above the recommended level. Since the exceeded level is very small, we can conclude that the interference level at the Iridium earth stations is within allowable levels.

3.1.2 Odyssey Victim

Figure 3-16 illustrates the Iridium earth station interference with the Odyssey satellite.

Figure 3-17 shows the potential interference between the Iridium earth station at Las Vegas and the Odyssey satellites viewing the Odyssey earth stations at San Luis Obispo, CA

Figure 3-18 shown the potential interference between the Iridium earth station at Montpelier and the Odyssey satellite viewing the Odyssey earth station at Portland, Maine.

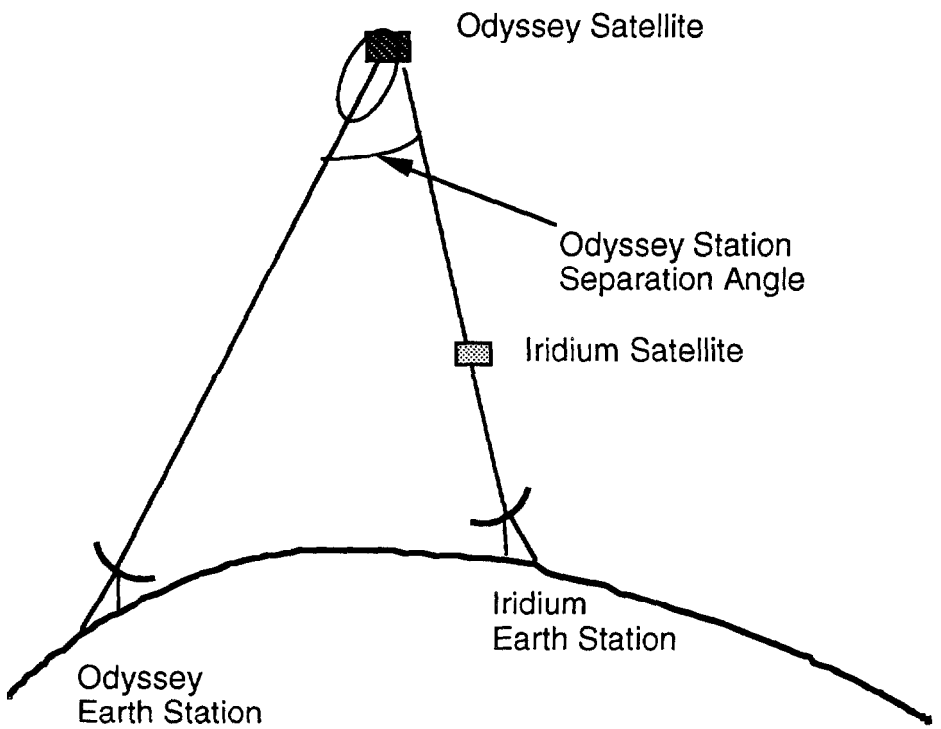

Figure 3-16: Iridium Station Interference With Odyssey Satellites

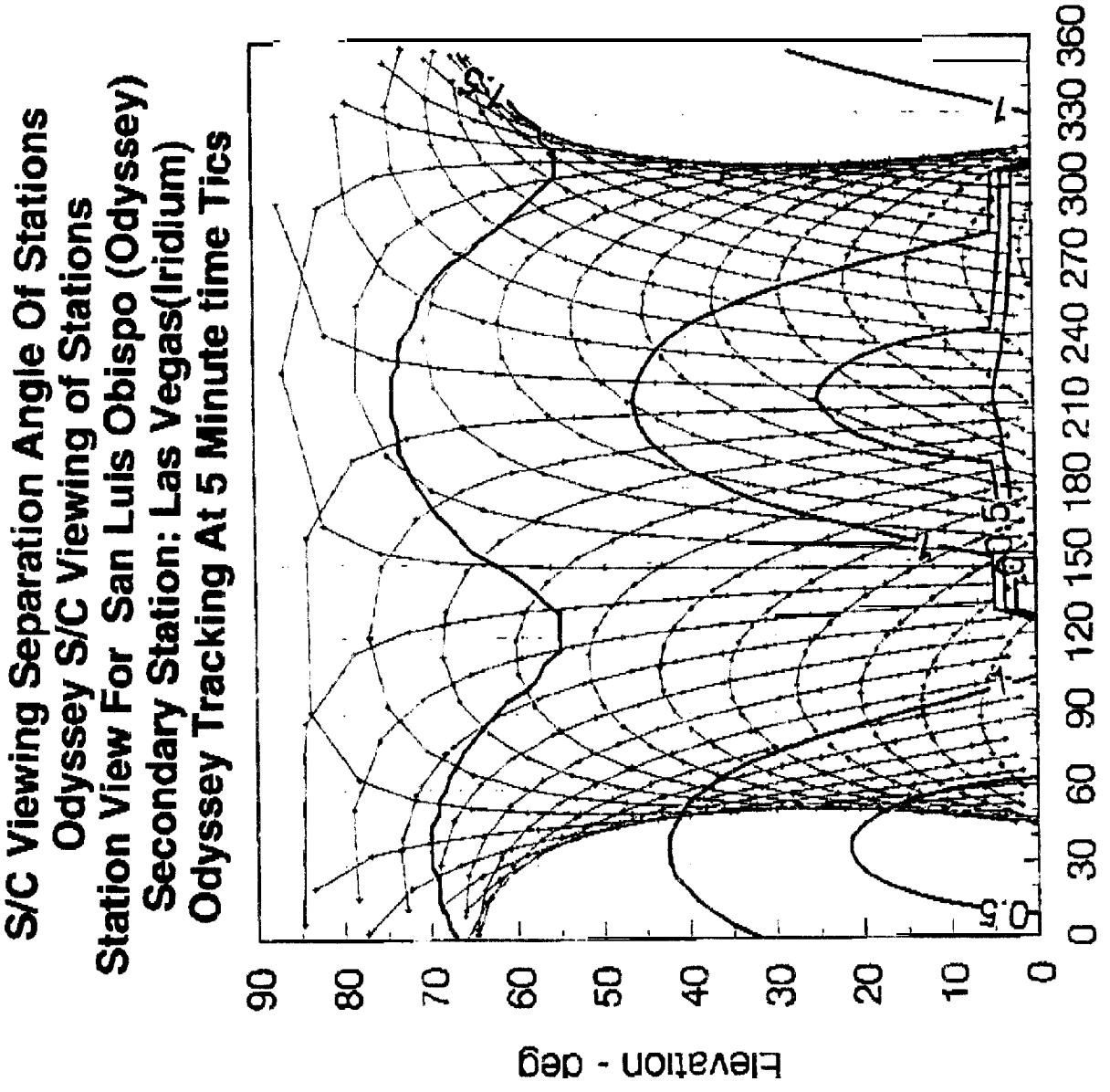
S/C Viewing Separation Angle Of Stations
Odyssey S/C Viewing of Stations
Station View For San Luis Obispo (Odyssey)
Secondary Station: Las Vegas(Iridium)
Odyssey Tracking At 5 Minute time Tics
Elevation - deg
90
80
70
60
50
40
30
20
10
0
0 30 60 90 120 150 180 210 240 270 300 330 360
Azimuth - deg

Figure 3-17

S/C Viewing Separation Angle Of Stations
Iridium SK Viewing of Stations
Station View For Portland, Maine (Odyssey)
Secondary Station: Montpelier (Iridium)
Odyssey Tracking At 5 Minute time Tics

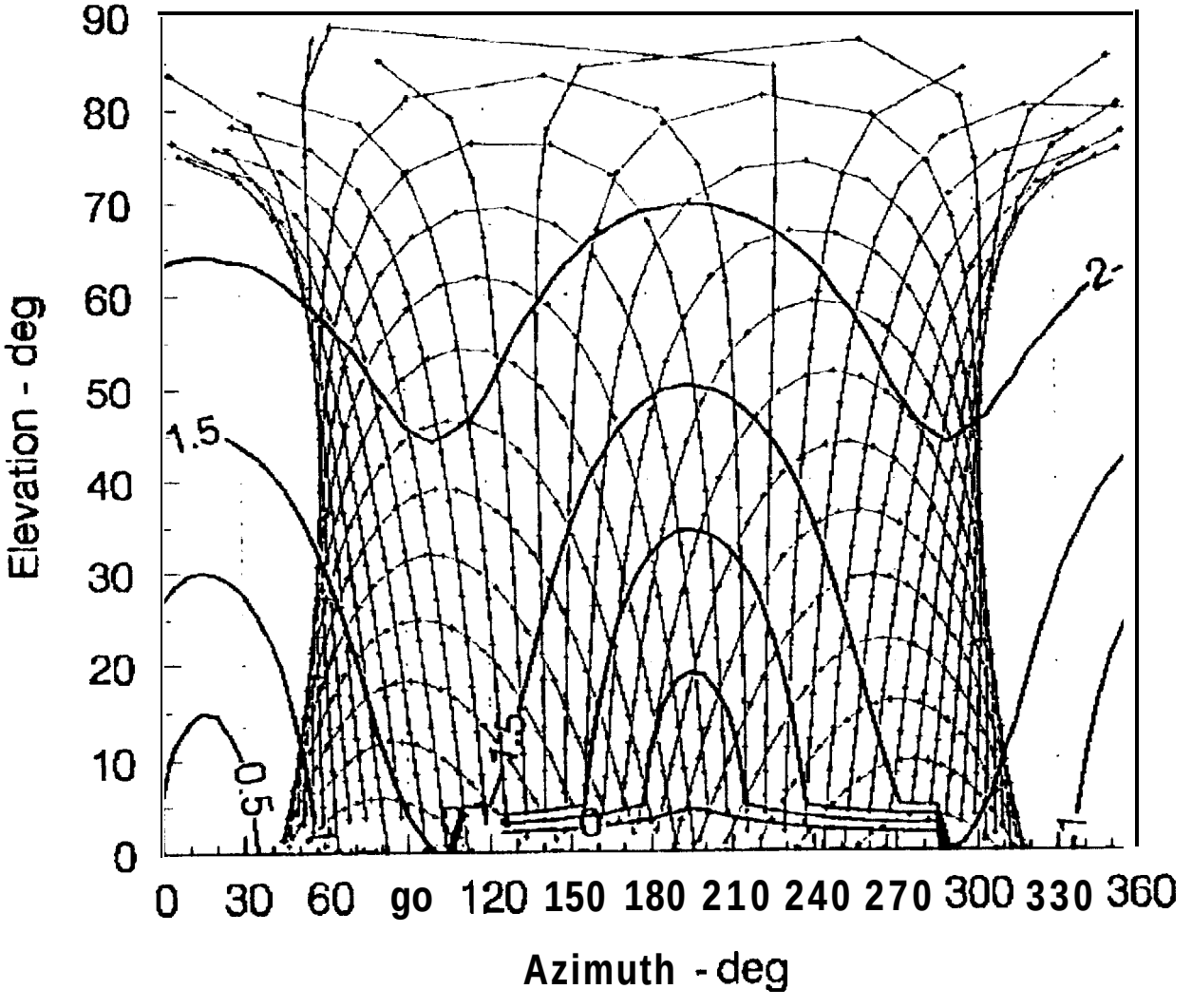

Figure 3-1 8

3.1.2.1 Uplink interference (Interference with Odyssey Satellite)

Table 3-3 summarizes the potential interference between Iridium earth stations and the Odyssey satellites

Recommended Criteria		Interference Levethe Odyssey Satellites at	
Max Allowed %Time	Interferenc Level	- From Iridium E/S at Las Vegas - Viewing to Odyssey E/S At San Luis Obispo, CA	- From Iridium E/S at Montpelier Viewing to Odyssey E/S At Portland, Maine
0.87	I= 0.06 N_T	-	
0.119	I = 0.78 N_T	0.0121 N_T	0.0369 N_T
0.0294	I = 2.98 N_T	0.2909 N_T	0.08890 N_T
IO.0004	I = 14.8 N_T	IO.5424 N_T	Il.6577 N_T

From Table 3-4, we conclude that the interference level at the Odyssey satellite is well below the recommended level.

3.1.1.1 Downlink interference (Interference with Iridium Earth Station)

The potential interference between Iridium satellites and the Odyssey earth stations are shown in Table 3-4.

Table 3-4: Interference Level At Odyssey Earth Stations

Recommended Criteria		Interference Level Odyssey Earth Stations at	
Max Allowed %Time	Interferenc Level	- From Iridium Satellite Viewing Iridium E/S a Las Vegas - Odyssey Earth Station at San Luis Obispo	-From Iridium Satellite Viewing Iridium E/S at Montpelier - Odyssey Earth Station at Portland, Maine
0.87	I= 0.06 NT		
0.119	I = 0.78 N_T	0.0001 N_T	0.0006 N_T
	I = 2.98 N_T	0.0006 N_T	0.0145 N_T
0.0004	I = 14.8 N_T	0.0011 N_T	0.0269 N_T

From Table 3-4, we conclude that the interference level at the Odyssey earth station are well below the recommended levels.

4.0 Conclusion

Based on our analysis, the level of interference at either the Odyssey satellite/earth station receiver or the Iridium satellite/earth station receiver are well below the recommended levels.

We conclude that the Iridium system and the Odyssey system can share the 28/19 GHz band for their feeder link .